DEPARTMENT OF THE INTERIOR
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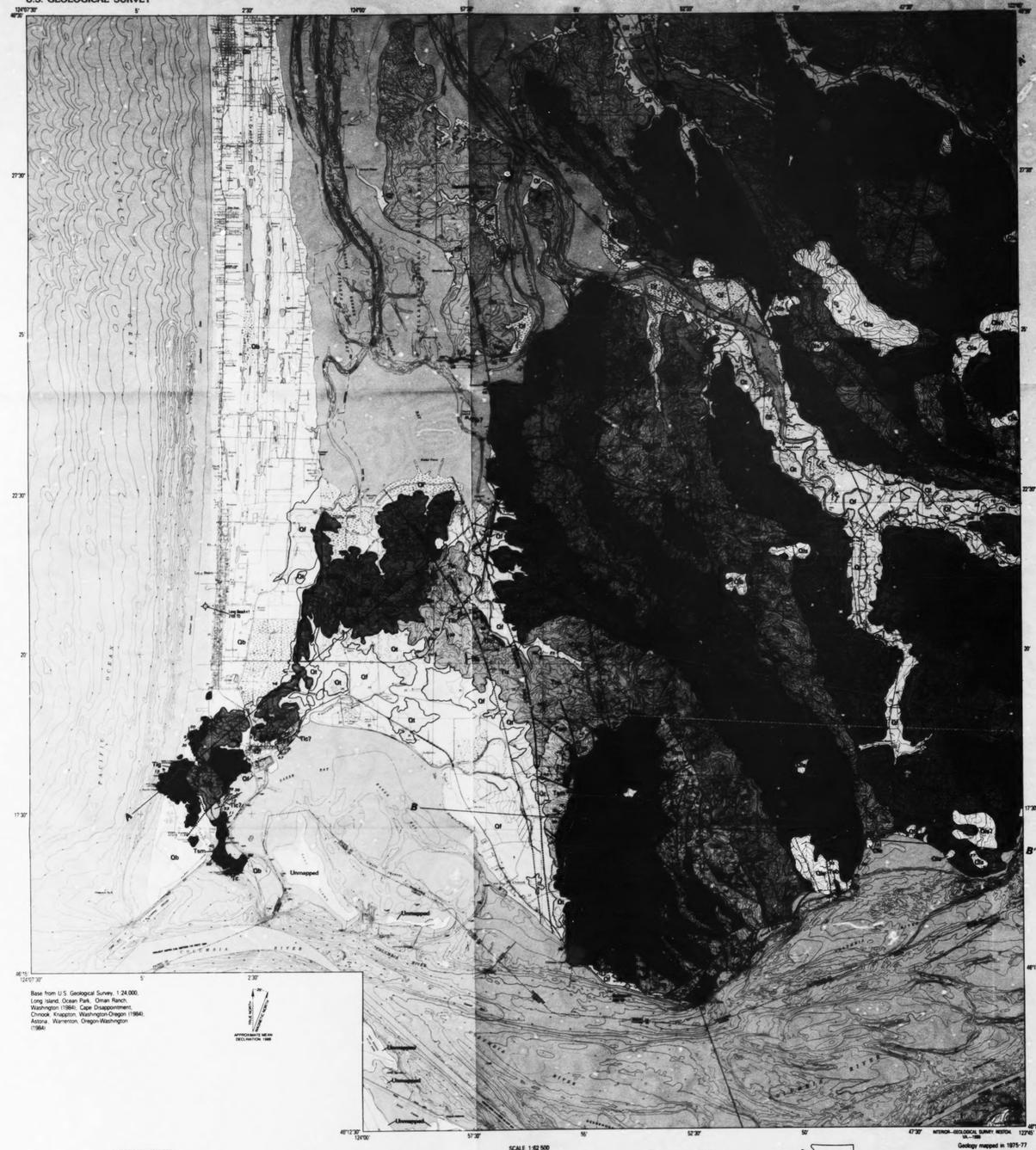
MISCELLANEOUS INVESTIGATIONS SERIES
MAP I–1832

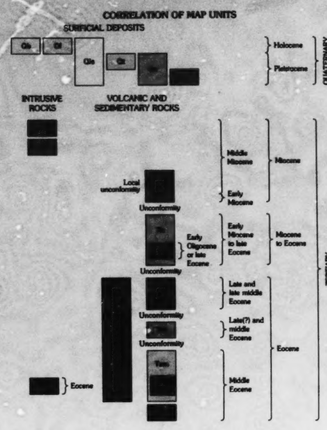


GEOLOGIC MAP OF THE CAPE DISAPPOINTMENT-NASELLE RIVER AREA, PACIFIC AND WAHKIAKUM COUNTIES, WASHINGTON

By
Ray E. Wells

1989

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS

Qb SHORELINE DEPOSITS (HOLOCENE)—Unconsolidated fine to coarse sand forming beach and longitudinal dune ridges of Long Beach Peninsula; locally includes organic-rich lacustrine sand, silt, and laminated muds between dune ridges and estuarine mud and sand along eastern shoreline

Qf FLUVIAL AND ESTUARINE DEPOSITS (HOLOCENE)—Unconsolidated clay, silt, sand, and gravel alluvium deposited along rivers and streams; also includes stabilized tidal flat deposits along the Columbia and Naselle Rivers and in Shoalwater Bay

Qls LANDSLIDE DEPOSITS (HOLOCENE AND PLEISTOCENE)—Large landslides of poorly sorted colluvium and coherent bedrock slump blocks; many small slides not shown on map

Qt ALLUVIAL AND ESTUARINE TERRACE DEPOSITS (PLEISTOCENE)—Unconsolidated clay, silt, sand, and gravel alluvium or estuarine deposits on terraces 8–20 m above sea level; primarily along Columbia, Naselle, and Nemah Rivers

Qm ESTUARINE DEPOSITS OF NEMAH RIVER (PLEISTOCENE)—Semi-consolidated, friable, planar-laminated to cross-laminated, thin-bedded to massive mudstone and fine- to medium-grained sandstone; locally includes sandstone channel fill with quartzite gravel stringers and slump blocks of laminated sediment; on terraces up to 80 m above sea level in lower Nemah and Naselle estuaries; as mapped on Long Island it includes Pleistocene beach and dune deposits

Qs SAND OF MOUNTAIN SPRINGS (PLEISTOCENE)—Semi-consolidated, laminated to massive, fine to coarse sand; commonly with yellow-orange to red iron oxide staining and characterized by planar lamination, broad gently dipping cross lamination, trough cross lamination, and localized channel fill with quartzite pebble stringers; forms hills east of town of Long Beach up to 100 m above sea level; may represent remains of an older barrier beach and dune field

VOLCANIC AND SEDIMENTARY ROCKS

Tb ASTORIA FORMATION (MIDDLE AND EARLY MIOCENE)—Divided into:

Bald Ridge unit (middle Miocene)—Thin-bedded, planar-laminated, abundantly micaceous and carbonaceous siltstone and lesser amounts of friable, very fine to coarse-grained micaceous feldspathic sandstone. Sandstone commonly occurs as graded beds, channel fills up to 15 m thick, and locally abundant clastic dikes; unit is well exposed along logging roads on Bald Ridge 2 to 5 km southeast of the town of Naselle. Unit overlies strata containing foraminiteral assemblages[1] referable to the Saucesian Stage of Kleinpell (1938) and is cut by sills of Grande Ronde Basalt chemistry (Tlb), locally of middle Miocene age; unit is lateral equivalent to upper unit of Astoria Formation of Wolfe and McKee (1968) and is probably correlative in part to Young Bay unit of Astoria Formation in the Astoria basin of northwest Oregon (Niem and Niem, 1985)

Tn Naselle unit (early and middle Miocene)—Massive-appearing, thick-bedded to massive bioturbated to wispy laminated, abundantly micaceous, carbonaceous, tuffaceous, medium-gray siltstone, sandy siltstone, and lesser fine- to medium-grained feldspathic sandstone; sandstone is locally basaltic or glauconitic; locally contains calcareous concretions. Good exposures occur in Salmon Creek east of Naselle and along logging roads east of the South Fork of the Naselle River. Contains foraminiteral assemblage referable to Saucesian Stage of Kleinpell (1938); unit is lateral equivalent to part of lower unit of Astoria Formation of Wolf and McKee (1968) and is similar in appearance and correlative in part to Wicklup Mountain unit of Astoria Formation in northwest Oregon (Niem and Niem, 1985)

Tlc LINCOLN CREEK FORMATION (EARLY MIOCENE TO LATE EOCENE)—Marine, dark-gray to olive-gray, concretion-bearing, very tuffaceous siltstone and lesser feldspathic sandstone; lower two-thirds is thin-bedded, laminated, burrowed tuffaceous siltstone and thin interbeds of graded, planar-laminated, fine- to medium-grained micaceous feldspathic sandstone, in places glauconitic or tuffaceous, especially at base of unit; large-scale soft-sediment deformation is common. Abundant sandstone near base of unit mapped separately as sandstone unit at Knappton (Tlck); upper third of unit is massive to laminated, poorly bedded, bioturbated, dark-gray siltstone and fine sandstone; white to tan tuff stringers and beds common throughout. Best exposures are in Dell Creek and along logging roads following Dell Creek and its tributaries. Formation contains foraminifers referable to Refugian and Zemorrian Stages of Schenck and Kleinpell (1936) and Kleinpell (1938); mollusean fauna from the uppermost part of the formation near Knappton are referable to the upper part of the *Liracassis apta* zone (Moore, 1984) and are thought to be of early Miocene age, although benthic foraminifers from the same locality are referable to the Zemorrian Stage, or Oligocene (W.W. Rau, oral commun., 1985). In part correlative with the Lincoln Creek Formation as mapped by Wolfe and McKee (1968) to the east and to the Smuggler Cove mudstone unit (Niem and Niem, 1985) and the Alsea Formation (Snavely and others, 1975) in Oregon. Locally includes:

Sandstone unit at Knappton (early Oligocene or late Eocene)—Light-gray, thick- to thin-bedded, graded and planar-laminated to trough-laminated, fine- to medium-grained micaceous feldspathic sandstone and lesser laminated siltstone, locally glauconitic or tuffaceous, with massive tuffaceous siltstone interbeds; includes thin-bedded sandstone sequences at several localities above sill on Bear River Ridge that may not be strictly correlative. Best exposures are along logging roads south of Bean Creek and along State Highway 401 at Knappton. Foraminifers from overlying siltstone generally referable to the Zemorrian Stage of Kleinpell (1938), while those beneath the sandstone are referable to the Refugian or Narizian Stages of Schenck and Kleinpell (1936) and Mallory (1959); may be deeper water facies correlative with sandstone of the Pittsburg Bluff Formation (Moore, 1976) in Oregon

Tts SILTSTONE AND SANDSTONE (LATE AND MIDDLE EOCENE)—Thin-bedded, laminated concretionary siltstone and fine micaceous sandstone in northeastern part of map; correlative with the siltstone of Cliff Point (Tcp), the siltstone and sandstone at Omeara Point (Top), and the siltstone of Shoalwater Bay (Tsb), undivided, and is laterally equivalent to part of Unit B of Wolfe and McKee (1968). As mapped on and near Long Island, may also include rocks correlative with the sandstone at Megler (unit Tsm)

Tsb SILTSTONE OF SHOALWATER BAY (LATE AND MIDDLE EOCENE)—Dark-gray, thin-bedded, laminated, indurated tuffaceous siltstone containing thin tuff beds, minor thin-bedded feldspathic sandstone, and calcareous concretions; unit is baked and altered over wide areas beneath the sill on Bear River Ridge; best exposures occur on U.S. Highway 101 along Shoalwater Bay. Foraminifers are referable to Narizian or Refugian Stages of Mallory (1959) and Schenck and Kleinpell (1936); unit is lateral equivalent of middle and upper part of Unit B of Wolfe and McKee (1968) and is correlative in part with siltstone of Skamokawa Creek (Wells, 1981); may be correlative in part with Nestucca, Cowlitz, and Lincoln Creek Formations of northwest Oregon (Wells and others, 1983)

Tsa SILTSTONE AND SANDSTONE AT OMEARA POINT (LATE AND MIDDLE EOCENE)—Light-gray, very well bedded, laminated, indurated siltstone and thin-bedded, planar-laminated and graded to cross-laminated, and graded, very fine grained micaceous feldspathic sandstone, locally basaltic, carbonaceous or tuffaceous with locally abundant calcareous concretionary beds; best exposed at Omeara Point on Shoalwater Bay. Contains foraminifers referable to the upper(?) Narizian Stage of Mallory (1959); may be correlative with part of the Cowlitz Formation near Longview, Washington (Livingston, 1966; Wells, 1981), and in northern Oregon (Warren and Norbirath, 1946; Wells and others, 1983)

Tsr SILTSTONE AT CLIFF POINT (LATE? AND MIDDLE EOCENE)—Green-gray to red-gray, indurated, burrowed, thin-bedded and laminated tuffaceous siltstone and very fine volcanolithic sandstone; breaks with conchoidal fracture across bedding; best exposed at Cliff Point on the Columbia River about 4 km east of the Astoria Bridge. Contains foraminifers referable to the Narizian Stage of Mallory (1959); partly correlative with lower part of siltstone of Unit B of Wolfe and McKee (1968) and upper part of McIntosh Formation (Pease and Hoover, 1957; Wagner, 1967a, b) in Washington; correlative with part of Yamhill Formation (Baldwin and others, 1955) in northern Oregon

Tsm SANDSTONE AT MEGLER (MIDDLE EOCENE)—Light-gray, indurated, thin- to thick-bedded and channeled, planar-laminated and graded to locally trough-laminated or cross-laminated, very fine to medium-grained micaceous feldspathic sandstone and interbedded siltstone, locally with sole markings of flute and groove casts; lowermost sandstones are in part basaltic and interfinger with basalt lapilli breccia and flows (unit Tbr) and pillow basalt flows (unit Tbl); best exposed near Megler rest stop 1.6 km east of Astoria Bridge. Contains foraminifers referable to upper Ulatisian or lower Narizian Stages of Mallory (1959); laterally correlative with Unit A of Wolfe and McKee (1968) and lower part of McIntosh Formation of Wagner (1967a, b) in Washington; may be correlative with lower part of Yamhill Formation in northern Oregon (Baldwin and others, 1955; Snavely and others, 1976a, b, c; Wells and others, 1983)

Tbr BASALT LAPILLI BRECCIA AND FLOWS AT FORT COLUMBIA (MIDDLE EOCENE)—Submarine basalt lapilli tuff, basalt breccia, and basalt sandstone and conglomerate; mostly thick-bedded to massive and locally graded, dark-green to brown-gray basalt lapilli tuff composed of vesicular basalt glass fragments cemented with calcite and zeolite, locally contains large plagioclase crystals up to 13 cm long; locally grades into medium to coarse basaltic sandstone; also includes massive basalt flow breccia and poorly sorted basalt boulder conglomerate; interbedded with the sandstone at Megler (unit Tsm) that contains foraminifers referable to the upper Ulatisian or lower Narizian Stages of Mallory (1959); may be correlative with Henriksen's (1956) Pe Ell Volcanics Member of the Cowlitz Formation. Locally includes:

Pillow basalt flows—Amygdaloidal fine-grained pillow basalt and lesser columnar-jointed basalt and breccia, commonly showing submarine alteration of glass to green smectite clays and abundant fracture fillings of zeolite, calcite, and quartz; also interbedded with the sandstone at Megler (unit Tsm)

Tcr CRESCENT FORMATION (MIDDLE EOCENE)—Pillowed, columnar-jointed, and massive basalt, fine to medium grained, nonvesicular to amygdaloidal, aphyric to plagioclase-pyroxene-olivine-phyric; typically shows submarine alteration of glassy pillow rims and interstitial glass to waxy green smectite clays. Clay minerals, zeolite, calcite, and quartz fill vesicles and abundant stickensided fractures; unit best exposed in sea cliffs at Cape Disappointment. Siltstone interbeds in upper part contain foraminifers referable to upper Ulatisian or lower part of the Narizian Stages of Mallory (1959). In northeast part of map area unit is laterally continuous and correlative with upper part of Crescent Formation as mapped by Wagner (1967a, b), Wolfe and McKee (1968), and Pease and Hoover (1957) in Washington. In the isolated Fort Columbia anticline, no foraminifers referable to the Ulatisian Stage have yet been found, but the stratigraphic relations there are identical to those of the upper part of the Crescent Formation in the northeast part of the map area and suggests that the two sequences are equivalent

INTRUSIVE ROCKS

Tob OLIVINE BASALT (MIDDLE MIOCENE)—Massive to crudely columnar and platy jointed, medium-grained, plagioclase-phyric olivine basalt, locally diabasic or micropegmatitic; forms large semi-concordant sill-like bodies in northeast part of map area; petrographically, chemically, and paleomagnetically similar to Pomona Member of Saddle Mountains Basalt of Columbia River Basalt Group (Snavely and others, 1973; Magill and others, 1982); rocks in report area previously assigned to the basalt of Pack Sack Lookout (Snavely and others, 1973); queried south of Naselle where paleomagnetic relations are uncertain

Tbs BASALT (MIDDLE MIOCENE)—Massive to crudely columnar and platy jointed, medium-grained, aphyric, dark-gray basalt; forms large sill on Bear River Ridge and several other large sill-like bodies; also as small irregular intrusions throughout sedimentary section, intruding strata as young as Bald Ridge unit of the Astoria Formation; petrographically, chemically, and paleomagnetically correlative with low Mg N2 polarity subdivision of the upper part of the Grande Ronde Basalt of the Columbia River Basalt Group as defined by Swanson and others (1979); rocks in report area previously correlated with the Depoe Bay Basalt (Snavely and others, 1973)

Tgb GABBRO AND BASALT (EOCENE)—Massive to crudely columnar jointed and locally banded or layered gray-green pyroxene gabbro and basalt; interstitial glass and cores of plagioclase commonly altered to clay minerals; intrudes Crescent Formation and overlying sandstone of Megler (unit Tsm)

[1]All foraminiteral age determinations by Weldon W. Rau, Washington Division of Geology and Earth Resources.

CONTACT—Approximately located or inferred. Dotted where concealed; queried where uncertain

FAULT—Approximately located or inferred. Dotted where concealed; queried where uncertain. Dip shown where known. U, upthrown side; D, downthrown side; arrows show sense of strike-slip motion. Faults located on the basis of shear zones, juxtaposed blocks of strata that have dissimilar strikes and dips, and (or) topographic lineations

THRUST FAULT—Approximately located or inferred. Sawteeth on upper plate

FOLDS—Showing inferred trace of axial plane and direction of plunge. Dotted where concealed

Anticline

Syncline

STRIKE AND DIP OF BEDS—Attitudes along river beds and on coastal wave-cut platform were measured on bedrock that is intermittently exposed

Inclined

Overturned

Horizontal

Vertical

STRIKE AND DIP OF FOLIATION

HORIZON CONTAINING ABUNDANT GLAUCONITE

ZONE OF MAXIMUM ALTERATION AND BAKING OF SEDIMENTARY ROCKS ADJACENT TO MIOCENE BASALT SILLS

DRY HOLE

TOTAL DEPTH—In feet

INTRODUCTION

The Cape Disappointment-Naselle River area is in southwestern Washington at the mouth of the Columbia River. The area encompasses several major estuaries and their adjacent highlands, which reach elevations of about 2,000 feet. Rainfall is abundant and produces heavy vegetation and deep weathering of the bedrock. Natural bedrock exposures are restricted to stream courses along larger drainages, although a network of logging roads provides excellent access to most of the area and widespread, but somewhat ephemeral, exposures of bedrock.

Published geologic mapping in the area includes a sketch map of southwest Washington geology in Weaver's 1937 monograph on the stratigraphy and paleontology of western Washington. Proprietary oil-company mapping that was published on the state geologic map (Huntting and others, 1961) also covers the area. Detailed geologic maps that cover stratigraphic sequences similar to those found in the Cape Disappointment-Naselle River area are available for adjacent quadrangles (Wolfe and McKee, 1968, 1972; Wagner, 1967a, b) and nearby areas (Pease and Hoover, 1957; Snavely and others, 1958; Gower and Pease, 1965; Livingston, 1966; and Wells, 1981).

The primary purpose of this investigation is to provide a geologic tie between known geology on land and offshore seismic reflection lines that were run by the U.S. Geological Survey (Snavely and Wagner, 1982; Snavely, 1987). Major goals of this project included (1) the correlation of coastal exposures of deep-water marine Tertiary strata with well-defined stratigraphy elsewhere in the Coast Range and (2) the definition of major structures along this segment of an active convergent margin. The author spent approximately six months mapping the area during the summers of 1975 to 1977 and published a preliminary open-file report in 1979 (Wells, 1979). Weldon W. Rau of the Washington State Division of Geology and Earth Resources made the foraminiteral determinations and Warren D. Addicott and Ellen J. Moore of the U.S. Geological Survey made the megafossil identifications and correlations. Jorge Rodriguez and Chris Hathon provided able field assistance during the summers of 1976 and 1977. Insightful discussions about Coast Range stratigraphy with Parke Snavely, Jr., Alan Niem, and Weldon Rau are gratefully acknowledged.

GENERAL GEOLOGY

The Cape Disappointment-Naselle River area of southwest Washington lies along the westernmost exposed edge of the central Washington and Oregon Coast Range. The Coast Range consists of the exposed part of a Tertiary forearc basin that extends offshore and lies within an active convergent margin. Nearly 7 km of deep-water marine strata are exposed in northwest-trending, westward-vergent anticlinal uplifts in the map area. An outline of the stratigraphy of these rocks is included below and in the map description. Additional stratigraphic and petrographic information for correlative rocks is available in Wolfe and McKee (1972).

The oldest rocks in southwest Washington crop out in the cores of the anticlinal uplifts and are referred to the Crescent Formation, here considered to be of early and middle Eocene age. Pease and Hoover (1957) and Wolfe and McKee (1968, 1972) suggest the Crescent may locally extend into the upper Eocene, but four new radiometric dates from lavas in the upper part of the Crescent Formation in the Willapa Hills average about 49 Ma, and five dates from the Black Hills average about 54 Ma (Duncan, 1982). The late Eocene ages may be derived from microfossil assemblages collected from interbeds in basalt sill complexes that postdate Crescent volcanism (compare Pease and Hoover, 1957, and Wells, 1981) and may partly be a relict of earlier correlation schemes for benthic formtinifers (see Rau 1981). The Crescent Formation consists primarily of submarine-pillowed, columnar-jointed, and massive basalt flows. The basalt is chemically similar to those erupted in oceanic tectonic regimes (Snavely and others, 1968; Wolfe and McKee, 1972), and it is thought to represent either oceanic crust and seamounts accreted to the continental margin during the early and middle Eocene, or possibly the product of a continental margin-rifting episode (see Wells and others, 1984, for a summary of models). In the Cape Disappointment-Naselle River area, volcanism may have continued locally (possibly after a brief hiatus) during deposition of the overlying, continentally derived micaceous sandstone. Basalt lapilli breccia and pillow basalt flows interbedded with the sandstone are mapped separately from the Crescent Formation in this report and are called the basalt lapilli breccia (Tbr) and flows (Tbl) at Fort Columbia, after the good exposures at that locality. These breccias are probably correlative with breccias and flows near the top of the Crescent that are mapped elsewhere in southwest Washington, (Wagner, 1967a, b; Henriksen, 1956; Wells, 1981).

Deep-water marine sedimentary rocks overlying the pillow basalt basement range in age from middle Eocene to middle Miocene and consist primarily of thin-bedded, laminated tuffaceous siltstones and lesser amounts of sandstone, deposited primarily in outer shelf and slope environments. The oldest sedimentary unit is the middle Eocene sandstone at Megler (unit Tsm), named for exposures at the Megler rest stop, about 1.6 km east of the north end of the Astoria bridge. This unit consists of thin to thick, locally rhythmically bedded, micaceous feldspathic sandstone and lesser interbedded siltstone. Graded bedding and sole markings such as flute and groove casts suggest a turbidite origin for these rocks, although trough cross lamination occurs in some places. Indurated, thin-bedded, tuffaceous, deep-water marine siltstone units unconformably overlie the sandstone at Megler and are locally exposed along U.S. Highway 101 east of the Astoria bridge. They include the late(?) and middle Eocene siltstone at Cliff Point (unit Tcp), in part correlative to the tuffaceous upper part of the McIntosh Formation of Wagner (1967a, b), and the siltstone and sandstone at Omeara Point (unit Top) and the siltstone of Shoalwater Bay (unit Tsb), both of late middle and late Eocene age, which are deep-water correlatives to the coal-bearing, shallow-water marine Cowlitz Formation near Longview, Washington (Livingston, 1966; Wells, 1981), and in northern Oregon (Warren and Norbirath, 1946; Wells and others, 1983)

A regional unconformity occurs at the base of the overlying late Eocene to early Miocene Lincoln Creek Formation, as it does elsewhere in the Washington Coast Range. A micaceous, feldspathic, and locally glauconitic sandstone, the sandstone unit at Knappton (Tlck), occurs near the base of the unit and is probably a deep-water correlative of shallow-water sandstone described 40 km to the east of the map area near Cathlamet, Washington (Wells, 1981). The majority of the Lincoln Creek Formation in the map area consists of very tuffaceous siltstone containing abundant tuff beds and evidence of large-scale soft-sediment deformation.

Unconformably overlying the Lincoln Creek Formation is the early and middle Miocene Naselle unit of the Astoria Formation. It consists mostly of massive to poorly bedded, abundantly micaceous, carbonaceous, tuffaceous sandy siltstone and feldspathic sandstone and is correlative in part to the Wicklup Mountain unit of the Astoria Formation in Oregon (Niem and Niem, 1985). Overlying the Naselle unit with a local unconformity is the middle Miocene Bald Ridge unit of the Astoria Formation, which crops out along the axis of the Naselle syncline. The Bald Ridge unit consists primarily of thin-bedded and laminated, abundantly micaceous and carbonaceous siltstone and sandstone. Micaceous feldspathic sandstone also forms large channel fills and abundant sandstone dikes. This unit is probably correlative to the Youngs Bay unit of the Astoria Formation in northwest Oregon (Niem and Niem, 1985).

Middle Miocene basalt forms sills and dikes intruding all of the sedimentary rock units. They are petrographically, chemically, and paleomagnetically similar to the Grande Ronde Basalt and the Pomona Member of the Saddle Mountains Basalt (both of the Columbia River Basalt Group), which are exposed as flows 40 km to the east of the map area at Cathlamet. The two largest intrusive bodies are each several hundred meters thick and are composed of basalt (unit Tlb) of Grande Ronde chemistry at Bear River Ridge (Depoe Bay Basalt of Snavely and others, 1973) and olivine basalt (unit Tiob) of Pomona chemistry at Radar Ridge (basalt of Pack Sack Lookout of Snavely and others, 1973). Both sills are intruded at or near the late Eocene angular unconformity at the base of the Lincoln Creek Formation. The downstream location of the sills and their close proximity to westward-moving flows of the Columbia River Basalt Group, which have identical characteristics, suggests that these intrusive bodies are actually the distal remnants of invasive flows that shouldered aside the less lithified marine sediments above the unconformity. Apparent invasive relations also occur in northwest Oregon (Beeson and others, 1979; Niem and Niem, 1985).

Structure

Southwest Washington lies in the middle of a Cenozoic forearc region and has undergone several deformations. The major structures consist of north- to northwest-trending basement uplifts that expose the oceanic basalt basement of the Crescent Formation in their centers. The uplifts are generally asymmetric, seaward-verging anticlinoria with oversteepened west limbs. Four of these complexly faulted and folded uplifts occur in the Cape Disappointment area. Fold axes in the Crescent Formation and in the overlying sandstone at Megler are more north-trending than those in unconformably overlying rocks and suggest that a folding episode occurred during late middle Eocene time. Subsequent folding along more northwesterly trends has affected rocks as young as late middle Miocene (unit Tiob). Major reverse faults apparently bound the western margins of the uplifts, and their location is based on observation of the coincidence of sheared rock, steep dips, and major topographic linears. The Fort Columbia fault and the Naselle-Nemah River fault also have dramatic aeromagnetic expression (U.S. Geological Survey, 1984). Because of poor exposures, most faults are inferred, based on lack of correlation of stratigraphy and structure across topographic lineaments.

The Cape Disappointment area has also undergone significant clockwise tectonic rotation, as summarized in Wells and Coe (1985) and Magill and others (1982). The Crescent Formation basement at Cape Disappointment and at Fort Columbia has rotated about 65° clockwise, whereas the Crescent Formation north of the Naselle-Nemah fault has rotated about 20°. These large differential rotations predate the late middle Eocene unconformity and postdate the early folding of the Crescent Formation against the continental margin (Wells and Coe, 1985). Subsequent post-middle Miocene clockwise rotations of at least 16° have affected most of the Cape Disappointment-Naselle River area (Magill and others, 1982; R.E. Wells, unpublished data, 1982). Northeastward oblique convergence and the subduction of a sedimentary accretionary wedge beneath the frontal forearc may have facilitated the tectonic rotations (Wells and Coe, 1985). The possibility of thermally mature sedimentary rocks in the accretionary wedge thrust beneath the forearc sequence may have significant implications for renewed petroleum exploration in the area (Snavely and Wagner, 1982; Snavely, 1987). The three dry holes drilled in the area have all been located on Crescent basalt basement structures and have been relatively shallow holes. New targets may exist beneath an inferred basal thrust or in upper plate sandstones, such as the sandstone of Megler, immediately above such a thrust.

REFERENCES CITED

Baldwin, E.M., Brown, R.D., Jr., Gair, J.E., and Pease, M.H., Jr., 1955, Geology of the Sheridan and McMinnville quadrangles, Oregon: U.S. Geological Survey Oil and Gas Investigations Map OM–155, scale 1:62,500.

Beeson, M.H., Perttu, Rauno, and Perttu, Janice, 1979, The origin of the Miocene basalts of coastal Oregon and Washington: An alternative hypothesis: Oregon Geology, v. 41, p. 159–166.

Henriksen, D.A., 1956, Eocene stratigraphy of the lower Cowlitz River area, eastern Willapa Hills area, southwestern Washington: Washington Division of Mines and Geology Bulletin 43, 122 p.

Huntting, M.T., Bennett W.A.G., Livingston, V.E., Jr., and Moen, W.S., 1961, Geologic map of Washington: Washington Division of Geology and Earth Resources, scale 1:500,000.

Kleinpell, R.M., 1938, Miocene stratigraphy of California: Tulsa, Okla., American Association of Petroleum Geologists, 450 p.

Livingston, V.E., Jr., 1966, Geology and mineral resources of the Kelso-Cathlamet area, Cowlitz and Wahkiakum Counties, Washington: Washington Division of Geology and Earth Resources Bulletin 54, 110 p.

Magill, J.R., Wells, R.E., Simpson, R.W., and Cox, A.V., 1982, Post 12-m.y. rotation in southwest Washington: Journal of Geophysical Research, v. 87, p. 3761–3777.

Mallory, V.S., 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., American Association of Petroleum Geologists, 416, p.

Moore, E.J., 1984, Molluscan paleontology and biostratigraphy of the lower Miocene upper part of the Lincoln Creek Formation in southwestern Washington: Natural History Museum of Los Angeles County Contributions in Science 351, 42 p.

Moore, E.J., 1976, Oligocene marine mollusks from the Pittsburg Bluff Formation in Oregon: U.S. Geological Survey Professional Paper 922, 66 p.

Niem, A.R., and Niem, W.A., 1985, Geologic map of the Astoria Basin, Clatsop and northernmost Tillamook Counties, northwest Oregon: Oregon Department of Geology and Mineral Industries Oil and Gas Investigations 14.

Pease, M.H., Jr., and Hoover, L., 1957, Geology of the Doty-Minot Peak area, Washington: U.S. Geological Survey Oil and Gas Investigations Map OM–188, scale 1:62,500.

Rau, W.W., 1981, Pacific Northwest Tertiary benthic foraminiteral biostratigraphic framework—an overview, in Armentrout, J.M., ed., Pacific Northwest Cenozoic biostratigraphy: Geological Society of America Special Paper 184, p. 67–84.

Schenck, H.G., and Kleinpell, R.M., 1936, Refugian Stage of Pacific Coast Tertiary: American Association of Petroleum Geologists Bulletin, v. 20, p. 215–255.

Snavely, P.D., Jr., 1987, Tertiary geologic framework, neotectonics, and petroleum potential of the Oregon-Washington continental margin, in Scholl, D.W., Grantz, Arthur, and Vedder, J.G., eds., Geology and resources potential of the continental margin of western North America and adjacent ocean basins—Beaufort Sea to Baja California: Houston, Texas, Circum-Pacific Council for Energy and Mineral Resources Earth Science Series, v. 6, p. 305–335.

Snavely, P.D., Jr., Brown, R.D., Jr., Roberts, A.E., and Rau, W.W., 1958, Geology and coal resources of the Centralia-Chehalis district, Washington: U.S. Geological Survey Bulletin 1053, 159 p.

Snavely, P.D., Jr., MacLeod, N.S., Rau, W.W., Addicott, W.D., and Pearl, J.E., 1975, Alsea Formation—an Oligocene marine sedimentary sequence in the Oregon Coast Range: U.S. Geological Survey Bulletin 1395–F, 21 p.

Snavely, P.D., Jr., MacLeod, N.S., and Wagner, H.C., 1968, Tholeiitic and alkalic basalts of the Eocene Siletz River Volcanics, Oregon Coast Range: American Journal of Science, v. 266, p. 454–481.

———1973, Miocene tholeiitic basalts of coastal Oregon and Washington and their relations to coeval basalts of the Columbia Plateau: Geological Society of America Bulletin, v. 84, p. 387–424.

Snavely, P.D., Jr., MacLeod, N.S., Wagner, H.C., and Rau, W.W., 1976a, Geologic map of the Waldport and Tidewater quadrangles, Lincoln, Lane, and Benton Counties, Oregon: U.S. Geological Survey Miscellaneous Investigation Series Map I–866, scale 1:62,500.

———1976b, Geologic map of the Yaquina and Toledo quadrangles, Lincoln County, Oregon: U.S. Geological Survey Miscellaneous Investigation Series Map I–867, scale 1:62,500.

———1976c, Geologic map of the Cape Foulweather and Euchre Mountain quadrangles, Lincoln County, Oregon: U.S. Geological Survey Miscellaneous Investigation Series Map I–868, scale 1:62,500.

Snavely, P.D., Jr., and Wagner, H.C., 1982, Geologic cross section across the continental margin of southwestern Washington: U.S. Geological Survey Open-File Report 82–459, 10 p.

Swanson, D.A., Wright, T.L., Hooper, P.L., and Bentley, R.D., 1979, Revisions in stratigraphic nomenclature of the Columbia River Basalt Group: U.S. Geological Survey Bulletin 1457–G, 59 p.

U.S. Geological Survey, 1984, Aeromagnetic map of southwest Washington and northwest Oregon: U.S. Geological Survey Open-File Report 84–205, scale 1:250,000.

Wagner, H.C., 1967a, Preliminary geologic map of the Raymond quadrangle, Pacific County, Washington: U.S. Geological Survey open-file report [67–265], scale 1:62,500.

Wagner, H.C., 1967b, Preliminary geologic map of the South Bend quadrangle, Pacific County, Washington: U.S. Geological Survey open-file report [67–266], scale 1:62,500.

Warren, W.C., and Norbisrath, Hans, 1946, Stratigraphy of upper Nehalem River basin, northwest Oregon: American Association of Petroleum Geologists Bulletin, v. 30, p. 213–237.

Weaver, C.E., 1937, Tertiary stratigraphy of western Washington and northwestern Oregon: Washington University Publications in Geology, v. 4, 266 p.

Wells, R.E., 1979, Geologic map of the Cape Disappointment-Naselle River area, Pacific County, Washington: U.S. Geological Survey Open-File Report 79–389, scale 1:48,000.

———1981, Geologic map of the eastern Willapa Hills, Cowlitz, Lewis, Pacific, and Wahkiakum Counties, Washington: U.S. Geological Survey Open-File Report 81–674, scale 1:62,500.

Wells, R.E., and Coe, R.S., 1985, Paleomagnetism and geology of Eocene volcanic rocks in southwest Washington, implications for mechanisms of tectonic rotation: Journal of Geophysical Research, v. 90, p. 1925–1947.

Wells, R.E., Engebretson, D.C., Snavely, P.D., Jr., and Coe, R.S., 1984, Cenozoic plate motions and the volcano-tectonic evolution of western Oregon and Washington: Tectonics, v. 3, no. 2, p. 275–294.

Wells, R.E., Niem, A.R., MacLeod, N.S., Snavely, P.D., Jr., and Niem, W.A., 1983, Preliminary geologic map of the west half of the Vancouver (Wash.-Oreg.) 1° by 2° quadrangle, Oregon: U.S. Geological Survey Open-File Report 83–591, scale 1:250,000.

Wolfe, E.W., and McKee, E.H., 1968, Geology of the Grays River quadrangle, Wahkiakum and Pacific Counties, Washington: Division of Geology and Earth Resources Map GM–4, scale 1:62,500.

———1972, Sedimentary and igneous rocks of the Grays River quadrangle, Washington: U.S. Geological Survey Bulletin 1335, 70 p.

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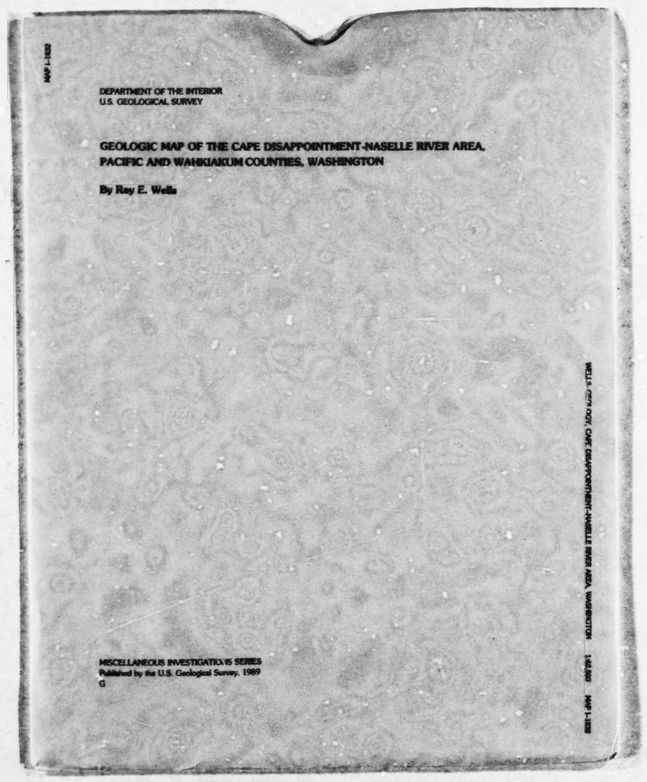
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